

# **ATTACHMENT "1"**

## Archaeological Site Protection Plan for Range 11T

### I. OVERVIEW

This report discusses site protection measures for the utilization of Range 11T (R11T) with the 105mm Mobile Gun System (MGS) mounted on the Stryker vehicle. This report sets forth the mitigation measures to protect known cultural sites that are within the Surface Danger Zone (SDZ) of the MGS at R11T.

The primary design factor for the modification of Range 11T was to limit, to the greatest extent possible, the number of archeological sites and features within the SDZ, while still achieving required operational standards. To achieve this goal, proposed firing points and target locations were revised several times in order to ensure that no archaeological sites would be in the direct line of fire of MGS weapons. Additionally, the vast majority of the archeological sites that are within the SDZ are along the very edges of the SDZ where the only possibility of impact is from indirect dispersion (ricochets), and even these impacts are exceedingly unlikely.

Archaeological sites discussed in this report include State of Hawaii sites 50-10-31-21285, 50-10-31-23463, 50-10-31-23455, 50-10-31-23458, 50-10-31-23621, 50-10-31-23626, referred to herein as sites 21285, 23455, 23458, 23463, 23621 and 23626. Figure 1 identifies the total or composite SDZ for the MGS, as well as the locations of archaeological sites within the SDZ. The composite SDZ represents the weapons SDZ for the .50 caliber, 7.62 caliber and the 105mm weapons utilized by the MGS. All of these weapons are required in order to meet qualification standards for the MGS and the protective measures detailed below account for the potential affects of all of the weapons. Figure 2 provides details such as site numbers and illustrates the layout of the range as well as sites that have been excluded from the SDZ through redesign of the range. Figure 3 depicts the southeast portion of the SDZ that is not shown in Figure 2.

Details and background regarding site 23621 can be found in the attached report titled *Draft Phase II Archaeological Investigations of an Excavated Pit Complex, Site 23621, at Pohakuloa Training Area, Hawai'i Island, Hawai'i May 2007* (Enclosure 1). Sites 21285, 23455, 23463, 23458 and 23626 are discussed in *Final Phase II Archaeological Research of Proposed Battle Area Complex (BAX) & Anti-Armor Live Fire and Training Range (AALFTR) Training Areas for Stryker Brigade Combat Team (SBCT) U.S. Army Pohakuloa Training Area, Island of Hawai'i, Hawai'i April 2006* (Enclosure 2). Enclosure 2 also discusses site 23621, but to a lesser degree of detail than Enclosure 1.

### II. SUMMARY OF ARCHEOLOGICAL SITES IN THE MGS SDZ

#### A. Site 23621

Site 23621 consists of 20 identified features, each containing numerous excavated pits, representing 136 excavated pits in total. The 23621 pit complex represents a relatively

small number of excavated pits located within the PTA boundary. Thousands of this type of archaeological feature exist within the boundaries of PTA.

Of the 20 archaeological features representing site 23621 there are 136 individual pits that have been recorded. Features 1, 4, 5, 6, 7, 12, 14, 16 (7 of 16 pits), 17, 18 (4 of 7 pits), 19 and 20 are outside the SDZ and are not threatened by activities proposed for R11T (Figure 4). Features 2, 3, 8, 9, 10, 11, 13, 15, 16 (9 of 16 pits) and 18 (3 of 7 pits) are inside the SDZ. The features inside the SDZ represent a total of 53 excavated pits.

#### ***B. Site 23626***

Site 23626 consists of two features, a lava tube/blister cave that was used for temporary habitation and small wall/alignment located opposite the entrance of the cave (Figures 5 and 6). Feature 1 lava tube extends from the south edge of the sink approximately 10 m southeast. The first 5.0 m length of the tube is 1.5 m wide and .8 m high and contains a loosely distributed grass. Site 23626 is located approximately 55 meters inside of the eastern boundary of the SDZ (Figure 4). Ungulates (goats and sheep) that use the site as a resting place represent the primary threat to this site. The site has been impacted from repeated trampling of archaeological deposits by ungulates. The PTA Cultural Resource Management (CRM) staff has utilized dead wood from local vegetation to construct a natural barrier at the entrance blocking the ungulates from entering. The site remains in good condition otherwise with no evidence of damage from previous military training.

#### ***C. Site 23455***

Site 23455 consists of an individually recorded excavated pit feature which is part of a larger complex containing 174 excavated pits. This feature is approximately 100 meters inside of the north boundary of the MGS SDZ (Figure 2).

#### ***D. Site 23458***

Site 23458 is composed of 14 volcanic glass quarries located in a pāhoehoe flow (k4 flow) formed approximately 300 years before present. This site is part of a larger quarry complex on the k4 flow east of Redleg Trail. This larger quarry complex contains over 400 individual quarry features. Three of the features of 23458 are located within the SDZ of R11T. They have been recorded as Features 1, 3 and 5 and are located to the south of Features 2 and 3 of the 23621 excavated pit complex (Figure 2). The volcanic glass quarries are located upon glassy crusts. Many of the quarries occur along ropey surfaces and vertical faces formed by uplifted lava (Figures 7-9).

#### ***E. Site 23463***

This site consists of a complex of excavated pits and is composed of 12 features representing a total of 68 pits. Only four of those pits, representing Feature 5 of site 23463, are located within the MGS SDZ. This site is similar in nature and type to site 23621.



#### **F. Site 21285**

Site 21285 consists of an entrance and two internal features, a firepit and possibly sleeping area. Evidence suggests it is a limited use occupation site. The entrance to the lava tube was apparently created by breaking away lava, evidenced by a small pile of rocks that appears to have been removed from this opening (Figure 10). Radio carbon dating suggests dates of *ca.* 12<sup>th</sup> to 13<sup>th</sup> centuries, which is consistent with other similar findings at PTA.

### **III. SITE PROTECTION**

The remainder of this report discusses site protection and mitigation methods for sites within the MGS SDZ. The sites and features included are 53 excavated pits from site 23621; lava tube sites 21285 and 23626; Features 1, 3 and 5 of volcanic glass quarry site 23458; Feature 5 of the excavated pit complex 23463; and the individual excavated pit from site 23455. These sites represent the total of archaeological sites and features within the present SDZ for the MGS weapon.

*Site protection methods and mitigations utilized include:*

- 1) **Avoidance through target placement and design.** Targets and firing positions have been placed such that all direct fire threats have been eliminated. No archaeological sites remain within line of sight firing positions.
- 2) **Natural topography.** The lava landscape provides a significant natural site protection barrier for excavated pit features (Figure 11). The nature of the terrain in R11T is undulating lava, both pāhoehoe and `a`ā. Numerous pit features are located behind uplifts and tumuli or in depressions, in addition to being down slope from direct fire. The Army utilized Laser Imaging Detection and Ranging (LIDAR) and geospatial software technology data, as well as visual inspections, to ascertain the spatial/elevation relationship between targets and range topography. This combination of analytical techniques, referred to in this report as "line of sight analysis," provided information regarding the protection provided by the natural topography at Range 11T and indicated where additional mitigation measures may be needed.
- 3) **Barrier protection.** Metal plates (target coffins) will be placed over those excavated pits that remain potentially threatened by indirect dispersion (ricochet). These target coffins are commonly utilized to deflect direct fire from pop-up target mechanisms and will provide excellent protection (Figures 23-24).

- 4) **Visual.** Range design incorporates clear signage to indicate both the left (east) and right (west/north) limits of fire on the range. No firing commences until a briefing is conducted and all soldiers have acknowledged awareness of these limits.
- 5) **Munitions.** Only non-explosive training rounds will be used at R11T.

#### IV. APPLICATION OF PROTECTION METHODS

##### A. *Avoidance Through Range Design and Natural Topography*

All road layouts, target positions and related intrusive activities have been carefully coordinated with the PTA CRM staff to ensure that all archaeological sites were avoided during construction activities (Figure 2). Additionally, cultural and archaeological monitors have been on-site during all construction activities to ensure there were no deviations from the planned locations and improvements. At this time, all major ground disturbing construction activity, such as modifying course roads, berms and primary target emplacements, has been completed and there have been no adverse impacts to any archaeological sites. Monitors will continue to observe any remaining limited ground disturbing activities that may be associated with completing the alternate target emplacements and the installation and testing of targets, electrical power, and communications equipment. Site protection for the sites and features outside the construction footprint, but within the composite surface danger zone (SDZ) for training, are discussed below.

The composite SDZ encompasses the areas where all munitions fired at R11T would land if there were no physical barriers in the way of the trajectory of weapons fire. The SDZ therefore does not take into consideration natural features such as the location of tumuli (lava uplift), hills, berms or cinder cones that would stop a round from progressing forward.

As noted in Enclosure 1 regarding excavated pit construction, this type of archaeological feature generally does not extrude from the landscape, but rather is primarily subterranean. The excavation of the feature leaves a crater or pit, with the materials removed remaining adjacent to the pit. These sites are effectively protected by an undulating surface or outcropping of rocks, such as those that populate the landscape of R11T. The natural landscape therefore provides protection to these excavated pit areas from both direct fire and from indirect dispersion, such as a ricochet or an errant round. Figures 11 and 12 indicate ways in which our analysis determined how natural landscape would provide protection to the archaeological sites. Figures 11 and 12 provide 3-dimensional images obtained from ArcView software utilizing LIDAR spatial imagery that gives excellent representation of the landscape. Figures 13-20 are created from software analysis that utilizes terrain elevations to indicate areas that are visible from a given position. Two techniques from this software are utilized. One produces a wide fan called surface coverage for an area from a single point as shown in Figures 15 and 17.



The darkly shaded areas indicate visibility from a firing position. Areas that are not darkly shaded are not visible from the firing position. The other method uses a single observer point and a target location, producing both a coded line and a visibility profile in graph form as shown in Figure 13. The green line indicates visibility and the red indicates no visibility. This is useful for looking at a specific resource or site, versus a group of sites.

Utilizing the line of sight analysis described above, which includes a combination of high resolution imagery and geospatial software technology, as well as visual inspection to confirm the resulting data, it has been determined that the present configuration of R11T has eliminated the threat of direct fire from the MGS weapons systems.

#### *1. Site 23621*

Nine features of site 23621 are inside of the SDZ. They are Features 2, 3, 8, 9, 10, 11, 13, 15, 16 (9 pits) and 18 (3 pits).

Feature 2 is located within the southeast extent of the 23621 pit complex (Figure 4). The closest target to Feature 2 is located approximately one kilometer to the northwest. There is no possibility of direct weapons fire damage from the MGS 105mm round to Feature 2 due to the configuration of the targets and firing boxes. The line of fire does not engage this feature. Indirect dispersion is mitigated by the location of Feature 2 to the east of the target positions. All ricochet potential is directed in fans from the target areas. Feature 2 remains outside of those fans. Additionally numerous tumuli (uplifts), exist between the firing positions and targets and this feature.

Feature 3 is located approximately 170 meters southeast of Feature 2. A line of sight analysis has determined that Feature 3 will not be affected by direct fire (Figures 13-14). Because the composite SDZ is an amalgamation of the SDZs for all of the weapons used by the MGS, portions of the SDZ may only have significance for a single weapon. The portion of the SDZ that encompasses Feature 3, for example, is the result of rounds fired from Battle Positions 2 and 3 using the 105mm gun canister rounds. The individual SDZs for the other weapons utilized by the MGS do not encompass Feature 3. Thus, only the 105 mm canister rounds must be analyzed to determine the level of protection afforded Feature 3 by the design of R11T. The canister rounds fired by the 105 mm gun are similar to shotgun rounds in that they lose nearly all velocity after 300 meters. Feature 3 is located 1.3 kilometers (4265 feet) from Battle Positions 2 and 3. Thus, it is virtually impossible for indirect dispersion from the 105 mm canister rounds to adversely impact the excavated pits representing Feature 3.

Feature 8 includes seven excavated pits which are located behind a large berm, which also functions as the location of the mover target 1 (mvr1) (Figure 12). There is approximately an 18.5 meter (60 feet) elevation difference between the target and the location of the excavated pits. This feature cannot be affected by direct fire or indirect dispersion from any of the firing positions due to the protection provided by this berm.

Feature 9 includes three excavated pits and is located 100 meters (328 feet) southeast of Feature 10. All pits are protected from direct fire due to the natural topography and have been evaluated using line of sight analysis (Figure 15 and 17). The feature is within the SDZ discussed for Feature 3 and for reasons discussed regarding Feature 3 this feature will not be threatened by indirect dispersion.

Feature 10 includes three excavated pits and is located behind a collapsed lava tube/trench. The ridges of this trench are providing a barrier that will protect this feature from any direct and indirect weapons fire. Line of sight analysis indicates that this feature is not visible from firing positions and is within the SDZ discussed for Feature 3 (Figures 15 and 17). For reasons discussed regarding Feature 3, this feature will not be threatened by indirect dispersion.

Feature 13 consists of nine excavated pits. The site is approximately 75 meters southeast of Feature 9 and is adjacent to the eastern boundary of the SDZ. Line of sight analysis indicates that this feature is not visible from firing positions BP2 and BP3 (Figures 15 and 17). This feature also lies within the SDZ discussed for Feature 3 and for the same reasons discussed with respect to Feature 3, will not be threatened by indirect dispersion.

Feature 15 contains one excavated pit and lies within a collapsed lava tube/trench. It cannot be fired upon since there is no line of sight. Indirect dispersion impacts are not possible since the site does not exist near any target areas that would permit indirect dispersion to be possible.

Feature 16 contains 9 excavated pits that are within the SDZ. The remaining 7 are outside of the SDZ. This portion of the SDZ represents rounds fired from Battle Positions 2 and 3 and is configured from a 105mm canister round. SDZ line of site analysis, using both surface coverage fan analysis and direct line of site analysis, was utilized in determining the potential of adverse impacts to those features within the SDZ. All pits are located behind a natural ridge formed from a collapsed lava tube. This is visible in Figure 12. The line of site analysis was performed for Feature 16 from BP2 and BP3 (Figures 15-18) confirming that these features will be protected from direct weapons fire due to natural topography. Due to the location of this feature, lying over 500 meters to the east of the target areas, located west of Mover 1, indirect dispersion is not a threat to this feature due to the limited travel distance of the 105mm canister after hitting the target area (refer to comments regarding Feature 3).

Feature 18 includes 3 excavated pits within the SDZ that are closest in proximity to a firing position of the MGS 105mm round (Figure 12). Protection of these pits includes the movement of Firing Box 1a (fb1a) 80 meters (262 feet) to the west and to the rear (north) of the firing area (Figure 22). This removes the firing window and effectively avoids the excavated pits in Feature 18. This was confirmed by stationing an individual at each of the excavated pit features as well as positioning another individual at the firing position. The individuals in the pits were hidden from the view of the firing position due to the terrain. In addition, range design experts stated that the limited downward angle of the MGS weapon would also not allow this area to be targeted. Indirect dispersion



would not physically be able to travel in the direction of Feature 18 from the target area due to the fact that munitions dispersion (ricochet) occurs in a fan outward and in the direction of fire. It will not travel backwards, which would be required in order to hit this feature.

2. Site 23626/Feature 11 of Site 23621

Site 23626, also previously recorded by Garcia and Associates (GANDA) as Feature 11 of site 23621, is located within the eastern portion of the SDZ. This portion of the SDZ represents the use of the 105mm canister round. This site is behind a collapsed lava tube and within an undulating lava terrain. Line of site analysis was performed from BP2 and BP3, in addition to FB1a (Figures 19-21). The analysis indicates that the site cannot be targeted from any of these positions and therefore remains protected from direct fire. Due to the location of this site, being situated over 500 meters to the east of the target areas and to the west of Mover 1, indirect dispersion is not considered a potential threat to this feature due to the limited travel distance of the 105mm canister after hitting the target area. Additionally the site lies in front of all targets. Potential dispersion and ricochet will not travel in reverse, but will continue in the direction of fire. This further eliminated the possibility of impact from indirect dispersion.

3. Site 23458

Features 1, 3 and 4 of the 23458 quarry site are located upon a highly undulating lava flow. These sites cannot be targeted with direct fire due to the elevated terrain found between these features and the firing positions. There is very minimal potential that indirect dispersion could possibly land upon one of the quarry areas due to the protective terrain. Due to the nature of the volcanic glass quarries themselves, which are intrusive occurrences upon virgin lava, indirect dispersion would have minimal impact. Additionally, it should be noted that there are over 400 quarried areas upon this particular lava flow, many of which provide much better examples of this type of archaeological feature.

4. Sites 21285 and 23463

Both the cave entrance of site 21285 and the four excavated pits of site 23463 remain five to six kilometers (about 3 miles) from firing positions. There is no possibility that either of these sites could be fired upon directly due to the natural topography in this area, which serves as a barrier to direct fire. This SDZ has been established for the use of the .50 caliber round, rather than the 105mm round. The chance of indirect dispersion impacting this area, given the significant distance from the firing position, is exceedingly unlikely.

**B. Barrier Protection**



Mitigation measures to be utilized for protecting the features discussed below will include the placement of target coffins over all excavated pits of these features. The target coffin is frequently utilized to deflect direct fire and protect the mechanism of a pop-up target base, such as the battery and the mechanics, and is made of ballistic steel (Figures 24 and 25). The target coffins will protect from direct fire from 7.62mm and .50 cal machine guns and MGS canister rounds and will protect from the indirect effects of all rounds utilized on R11T.

1. Site 21285

The SDZ for this area represents the use of a .50 caliber round, rather than the 105mm round. This site is adjacent to the SDZ boundary and any indirect dispersion that could potentially arrive at this position has no potential to damage the site. To eliminate the remote possibility that a round could in fact fall into the opening of cave site 21285, a target coffin will be installed before firing at R11T commences.

2. Site 23621

As noted previously, three excavated pits from Feature 18 are within the SDZ of the MGS. Although the three pits cannot be targeted, they will be fitted with the target coffins to ensure total protection of the features.

3. Site 23455

This singular excavated pit feature is not within any direct line of fire and is therefore protected. The topography of this particular area is not as protective as the eastern areas. Therefore, this pit will be fitted with a target coffin to enhance protection from possible indirect dispersion.

**B. *Visual Markings***

Both the left limit and the right limit of the SDZ for MGS is briefed to all soldiers before firing and there will be clear markings on the range to demarcate these boundaries. This will effectively ensure that firing will not impact the eastern areas, where additional features of site 23621 and cave site 23626 are located.


**V. ARCHAEOLOGICAL AND CULTURAL MONITOR RECOMMENDATIONS**

On 9 March, 2007 Archaeological Monitor Wendy McElroy and Cultural Monitor Naomi Leiola Mitchell performed a site visit to inspect the excavated pits associated with Site 23621 on R11T at Pōhakuloa Training Area. The purpose of the visit was to assess the potential threat of adverse impacts to the excavated pits that were located close to firing position 1. The excavated pits located at Feature 18 were visited. The visit occurred prior to the movement of the firing position to the west. The monitors concluded that the threat of potential adverse impact to the feature was highly unlikely and concurred that

the natural topography offers protection to the features. Additionally, the monitors recommended that site protection remain minimal and non-intrusive. Building berms was thought unnecessary and was considered an invasive modification to the landscape. At the time of the visit, the target coffins had not been considered. In subsequent discussions with the monitors regarding this use of the target coffins, it was agreed they would provide an excellent and non-invasive measure for protecting the excavated pit features from potential indirect fire. The trip report summary can be found at Enclosure 3.

## VI. CONCLUSION

A total of 6 archaeological sites are located within the SDZ for the MGS. The range layout, firing positions and SDZs have been carefully planned to avoid impacts to all known archaeological features. The combination of mitigation measures, including avoidance through strategic target placement and firing locations, natural topography, protective barriers and clear marking of left and right limits, effectively mitigates damage to any of the known archaeological sites within this SDZ. The Cultural Resource Manager has determined that these measures are adequate to protect the sites within the SDZ and that the use of this existing range for MGS operations will not have an adverse effect on any archaeological sites identified within the R11T SDZ and is therefore exempt from further consultation requirements pursuant to paragraph V.B(4) of the Programmatic Agreement Among the United States Army Garrison, Hawaii, the Hawaii State Historic Preservation Office and the Advisory Council on Historic Preservation for Section 106 Responsibilities for the Army Transformation of 2nd Brigade, 25th Infantry Division (Light) to a Stryker Brigade Combat Team.

  
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